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(54) **Anti-noise generating equipment for motor vehicles**

(57) The equipment (1) comprises

tem against intrusions into said space (3).

first acoustic-electric transducers (2) for providing electrical signals indicative of the noise in a space in the motor vehicle,

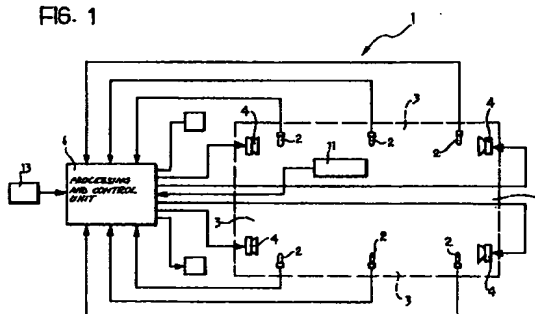
second electric-acoustic transducers (4), and

an electronic unit (6) which, in a first operating mode, can pilot the second transducers (4) in dependence on the signals provided by the first (2) so as to cause the generation of pressure waves (anti-noise) which can cancel out the noise waves.

The unit (6) can also selectively implement a second operating mode, alternative to the first, in which

- it pilots the second transducers (4) so as to cause the generation of pressure waves of predetermined characteristics in said space (3),
- it detects the signals correspondingly provided by the first transducers (2),
- it compares predetermined characteristics of these signals with those of reference signals or data previously stored, and
- it generates alarm and/or locking signals when the characteristics of the signals provided by the first transducers (2) differ from those of the reference signals or data so that, in the second operating mode, the equipment (1) operates as an alarm sys-

FIG. 1



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## Description

The present invention relates in general to equipment for generating anti-noise for use in motor vehicles.

More specifically, this invention relates to equipment comprising

first acoustic-electric transducer means for providing electrical signals indicative of the noise generated in a space in the motor vehicle,

second electric-acoustic transducer means, and

an electronic processing and control unit which is connected to the first and second transducer means and, in one (first) operating mode, is adapted to pilot the second transducer means in dependence on the signals provided by the first so as to cause the generation, in said space, of pressure waves (anti-noise) which can at least partially cancel out the noise waves.

In known equipment of this type, microphones are typically used as acoustic-electric transducers and loud speakers as electric-acoustic transducers. In this equipment, the electronic processing and control unit is arranged to cause the generation, by means of the loud speakers, of pressure waves tending to be of same amplitude as the noise waves but in phase opposition thereto, in order to generate a cancelling effect with a consequent considerable reduction in the level of noise noticeable in the space controlled which, typically, is the passenger compartment of the motor vehicle.

The present invention proposes equipment for generating anti-noise of the type specified, characterized in that

it further comprises selector means capable of supplying to the processing and control unit signals for prearranging it selectively to implement the (first) operating mode or a second operating mode, alternative to the first, and in that

in the second operating mode, the unit is arranged to carry out the following steps:

- to pilot the second transducer means so as to cause the generation, in said space, of pressure waves with predetermined characteristics,
- to detect signals correspondingly provided by the first transducer means,
- to compare predetermined characteristics of these signals with those of reference signals or data previously stored, and
- to generate alarm and/or locking signals when the characteristics of the signals provided by the first transducer means differ significantly from those of the reference signals or data,

so that, in the second operating mode, the equipment operates as an alarm system against intru-

sions into said space.

According to a further characteristic, the equipment according to the invention is also characterized in that the processing and control unit is arranged

to acquire voice signals by means of the first transducer means,

to analyze and compare predetermined characteristics of the voice signals acquired with those of reference voice signals previously stored, and

to generate alarm and/or locking signals usable to prevent the operation of equipment or a device of the motor vehicle when the voice signals acquired differ significantly from the reference voice signals stored.

Further characteristics and advantages of the invention will become clear from the following detailed description given purely by way of non-limiting example with reference to the appended drawings, in which:

Figure 1 is a block diagram of equipment according to the invention, and

Figure 2 is a block diagram of a processing and control unit included in equipment according to the invention.

In Figure 1, equipment for generating anti-noise according to the invention is generally indicated 1.

In the embodiment shown by way of example, this equipment comprises six acoustic-electric transducers, particularly microphones, indicated 2, arranged in a space in the motor vehicle, particularly in the passenger compartment which is shown schematically in broken outline and indicated 3 in Figure 1.

The equipment also comprises, for example, four electric-acoustic transducers, particularly loud speakers or sets of loud speakers, indicated 4.

The microphones 2 and the loud speakers 4 are connected to corresponding inputs and to corresponding outputs, respectively, of an electronic processing and control unit, generally indicated 6.

The processing and control unit 6 may be formed, for example, in the manner which will now be described with reference to Figure 2.

In this embodiment described by way of example, the unit 6 comprises signal-amplifying and -conditioning circuits, generally indicated 7, the inputs of which are connected to the microphones 2. The outputs of these circuits are connected to analog/digital conversion devices 8, the outputs of which are connected to a digital signal processor DSP with which memory devices MEM are associated.

The digital signal processor DSP is arranged, for example, by means of suitable programmes based, for

example on "fuzzy logic" techniques, in a first operating mode, to acquire electrical signals or data generated by means of the microphones 2 and indicative of the noise generated in the region 3 of the motor vehicle. In dependence on the noise signals thus acquired, the digital signal processor pilots the loud speakers 4 by means of digital/analog conversion devices 9 and output amplifier stages 10 so as to cause the generation, in said space 3, of pressure waves (anti-noise) which can cancel out at least some of the noise waves.

"Car stereo" equipment, such as radio receivers, compact-disc readers, tape readers, etc. may also advantageously, but not necessarily, be connected to the processing and control unit 6, according to a known technique. The block indicated 11 in Figure 1 represents one or more of these devices.

The processing and control unit 6 may have suitable signal-amplifying and -conditioning circuits 12 the outputs of which are connected to the A/D conversion devices 8, as shown in Figure 2, in order to control the signals coming from the "car stereo" devices 11. The digital signal processor DSP is then correspondingly arranged to pilot the loud speakers 4 by means of the D/A convertors and the output amplifiers 10 so as to cause anti-noise pressure waves and vocal/musical sound signals to be generated simultaneously in said space 3.

The equipment described above, according to the invention, can operate as an alarm system against intrusions into the passenger compartment 3 as well as an anti-noise generation system.

For this purpose, the equipment also comprises a selector device, indicated 13 in Figure 1, which is connected to the processing and control unit 6 in order to provide this unit with signals for prearranging it selectively to implement the (first) operating mode described above or a second operating mode, alternative to the first, which will now be described.

The digital signal processor DSP is arranged to pilot the loud speakers 4 (by means of the D/A converter 9 and the amplifiers 10) so as to cause pressure waves of predetermined characteristics having, for example, frequencies within the ultrasound range, to be generated in the passenger compartment 3. The processor DSP is also arranged to acquire the signals correspondingly provided by the microphones 2, which constitute a representation of the "acoustic response" of the passenger compartment 3.

Data corresponding to the acoustic response of the passenger compartment 3 under predetermined conditions (passenger compartment closed and empty, etc.) are advantageously stored in the memories associated with the processor DSP and the acoustic response obtained by the activation of the loud speakers and the acquisition of the signals correspondingly supplied by the microphones 2 is periodically compared with these reference data. If the acoustic response detected differs significantly from that stored, the processor DSP generates an alarm and/or blocking signal.

In the second operating mode just described, the equipment thus advantageously achieves an effective and reliable volumetric protection of the space in the passenger compartment against intrusions.

The reference acoustic response of the passenger compartment can be stored in the memory devices associated with the processor DSP from the start or may be acquired by the processor, by means of a first activation of the loud speakers 4 and the corresponding acquisition of the signals supplied by the microphones 2, each time the motor vehicle is left.

Any alarm signals generated by the processor DSP in the second operating mode can be used to activate acoustic and/or optical alarm devices or to disable the operation of devices or units essential for the use of the motor vehicle. These signals can be used, for example, to prevent the engine of the motor vehicle from being started, etc..

The selector device 13 which prearranges the processing and control unit 6 to operate so as to generate anti-noise or as an anti-intrusion system may be constituted, for example, by a device which can receive a signal from a remote-control device such as those currently used for the remote control of the closing/opening of the motor-vehicle doors.

Alternatively, the selector device 13 may be constituted by a sensor which can detect the inserted/non-inserted condition of the ignition and starter switch key of the motor vehicle in order to enable the processing and control unit 6 to generate anti-noise waves when the key is inserted in the ignition and starter switch and is disposed in the "running" position. The enabling of the anti-noise wave generation may also possibly be conditional upon the detection of the running condition of the engine by means of sensor devices of known type, not shown.

The selector device 13 may be formed in various other ways which are clear to experts in the art. It may, for example, be constituted by a simple switch operable manually by the user.

The equipment according to the invention described above achieves an advantageous functional synergy.

A further advantageous functional synergy may be achieved by the arrangement of the processor DSP, in the second operating mode described above, to acquire voice signals by means of the associated microphones 2 and to analyze and compare predetermined characteristics of the voice signals thus acquired with those of reference voice signals previously stored and to generate alarm or locking signals when the signals acquired differ significantly from those stored. This additional function enables the equipment according to the invention to operate as a voice-identification and -recognition system. One or more passwords can thus be stored in the memories associated with the processor DSP for each authorized user of the motor vehicle, the processor DSP being arranged to compare the password spoken by a user entering the passenger compartment with

that stored in order to generate a signal to enable/disable devices or equipment essential for the use of the motor vehicle.

The recognition, at voice level, of a password spoken by the user of the motor vehicle may also be used for prearranging the processing and control unit 6 to operate in the second operating mode (anti-intrusion system) and for arranging the unit to operate so as to generate anti-noise waves again.

In the case of motor vehicles having devices which are adjustable electrically in a programmable manner, such as electrically adjustable seats and rear-view mirrors, etc., the vocal password-recognition capability enables corresponding personalized arrangements of these devices to be associated with certain passwords.

Naturally, the principle of the invention remaining the same, the forms of embodiment and details of construction may be varied widely with respect to those described and illustrated purely by way of non-limiting example, without thereby departing from the scope of the present invention as defined in the appended Claims.

#### Claims

#### 1. Equipment (1) for generating anti-noise for motor vehicles, comprising

first acoustic-electric transducer means (2) for providing electrical signals indicative of the noise in a space in the motor vehicle,

second electric-acoustic transducer means (4), and

an electronic processing and control unit (6) which is connected to the first and second transducer means (2, 4) and, in one (first) operating mode, is adapted to pilot the second transducer means (4) in dependence on the signal provided by the first (2) so as to cause the generation, in said space (3), of pressure waves (anti-noise) which can cancel out at least some of the noise waves, characterized in that

it also comprises selector means (13) capable of supplying to the unit (6) signals for selectively prearranging it to implement the first operating mode or a second operating mode, alternative to the first, and in that

in the second operating mode, the unit (6) is arranged to carry out the following operations:

- to pilot the second transducer means (4) so as to cause the generation of pressure waves of predetermined characteristics in said space (3),

- to detect the signals correspondingly provided by the first transducer means (2),

- to compare predetermined characteristics of these signals with those of reference signals or data previously stored, and

- to generate alarm and/or locking signals when the characteristics of the signals provided by the first transducer means (2) differ significantly from those of the reference signals or data, so that, in the second operating mode, the equipment (1) operates as an alarm system against intrusions into said space (3).

#### 2. Equipment according to Claim 1, in which the first and second transducer means (2, 4) are arranged to operate in the audible sound-frequency range in the first operating mode, the equipment being characterized in that the first and second transducer means (2, 4) are also arranged to operate in the ultrasonic sound-frequency range in the second operating mode.

#### 3. Equipment according to Claim 1 or Claim 2, characterized in that the processing and control unit (6) is also arranged:

to acquire voice signals by means of the first transducer means (2),

to analyze and compare predetermined characteristics of the voice signals acquired with those of reference voice signals previously stored, and

to generate alarm and/or locking signals usable to prevent the operation of equipment or a device of the motor vehicle when, upon the basis of a predetermined criterion, the voice signals acquired differ significantly from the reference voice signals stored.

FIG. 1

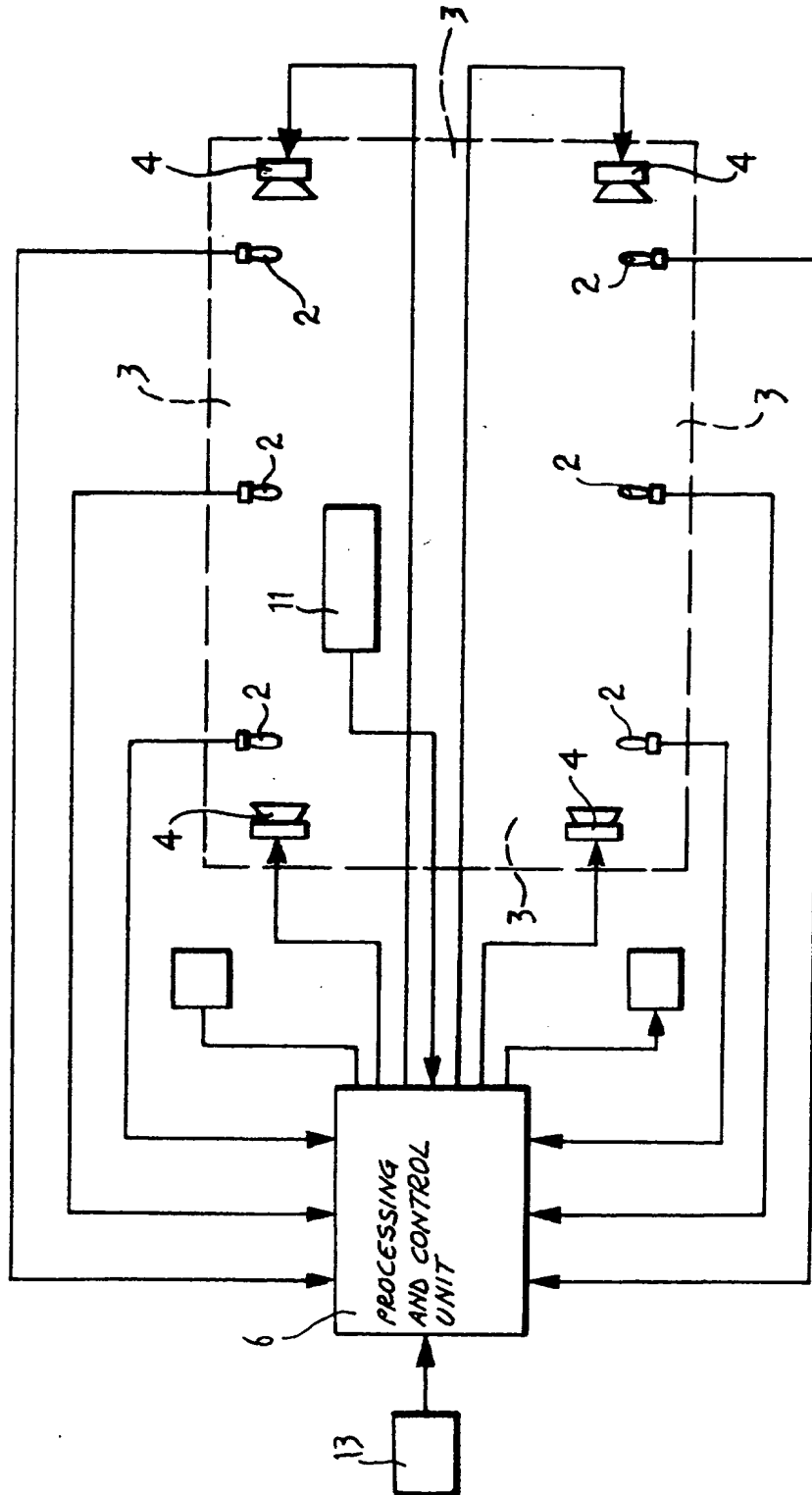
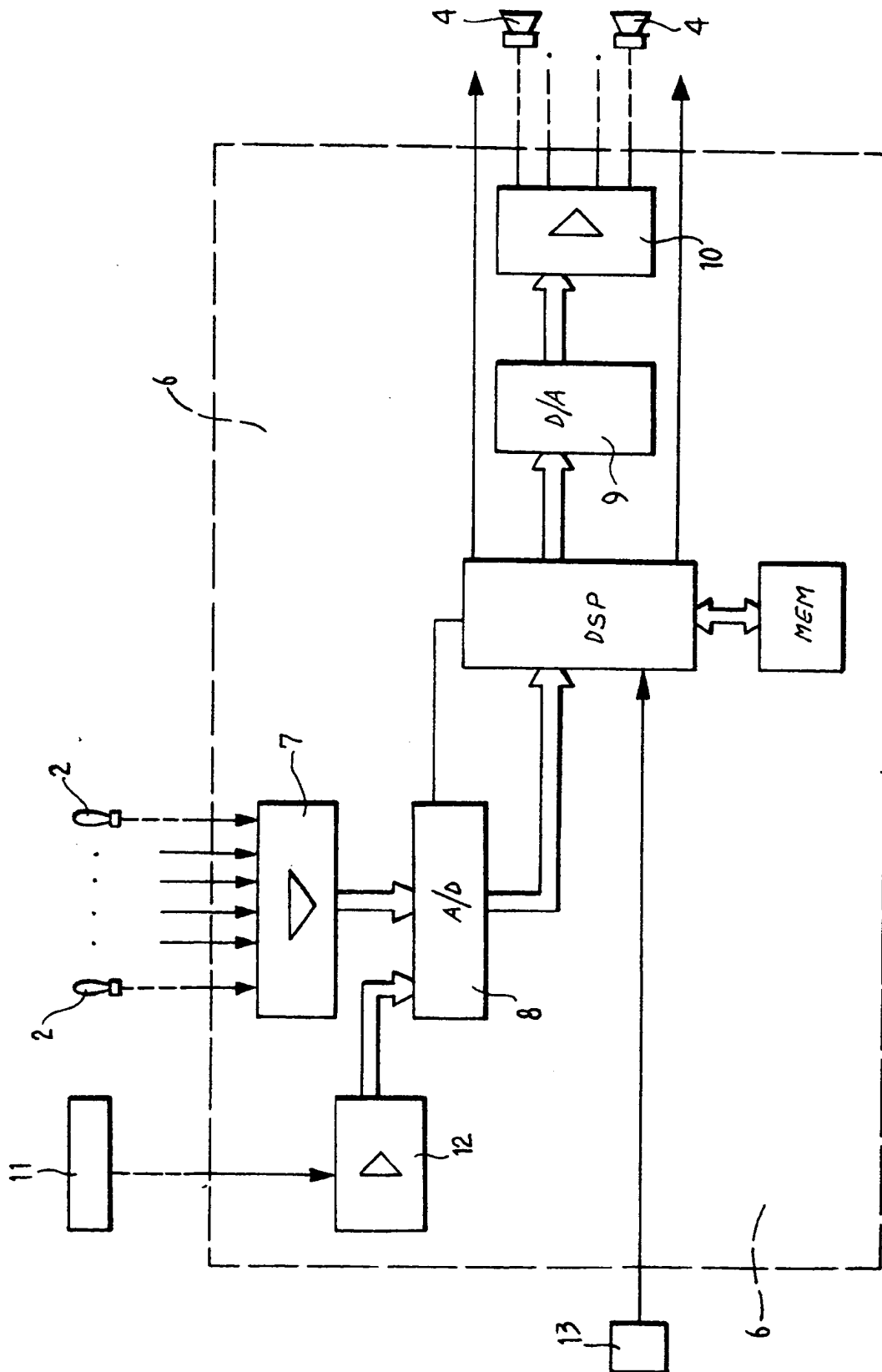


FIG. 2







European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 96 10 8986

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	WO-A-91 15896 (ACTIVE NOISE AND VIBRATION TECHNOLOGIES) 17 October 1991	1,3	G10L3/02 G01R33/385 G10L3/00
A	* page 1, line 17-20 *	2	
	* page 4, line 10 - page 5, line 8 *		
	* page 7, line 29 - page 8, line 15 *		
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Y	US-A-4 856 072 (SCHNEIDER ET AL.) 8 August 1989	1,3	G10L G01R B60R H03J
A	* column 1, line 5-7 *	2	
	* column 2, line 23 - column 7, line 9 *		
	---		
A	DE-A-41 06 405 (RICOH) 26 September 1991	1,3	
	* column 1, line 11-21 *		
	* column 3, line 4 - column 11, line 19 *		
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		2 September 1996	Zanti, P
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